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SCIENCE.

FRIDAY, JANUARY 9, 1885.

COMMENT AND CRITICISM.

IN ANOTHER part of this number, Professor Hilgard takes exception to our views of the proper functions of agricultural experiment-stations, as stated some weeks ago. Yet "to render to the agricultural population the scientific aid which they so sorely need when brought face to face with new and untried conditions," is precisely what we understand to be the object of experiment-stations. The question simply is, How shall such scientific aid be best afforded? Shall the experiment-station seek to reach an *empirical* solution of one problem after another as it may be presented to it, or shall it search into the elementary conditions of the most important of those problems, and thus endeavor to work out a *rational* solution? The view which we hold, and which seems to be indorsed by the paragraph we quoted in our comments of Dec. 5 from Director Sturtevant's report, is that it should do both; proportioning the amount of the two kinds of work according to the necessities of the particular case, but endeavoring to do as much work of the kind last mentioned as possible. We believe that work of the latter class should be held in the higher esteem, and that the constituency of the station should, if possible, be brought so to regard it, because its results are of vastly more permanent value. We do not hold that it should necessarily, or even usually, be placed first in the order of time, or that it should ever become the exclusive work of any public experiment-station.

Our suggested differentiation of agricultural experimentation would proceed upon a somewhat different basis, giving to the experiment-station proper the working-out of scientific results (empirical or rational, as the case may be), and to the experimental farm the verification

of these results under the actual conditions of farm practice. We do not deny the advantages of uniting these two kinds of work in one institution when possible; but the men who combine the high scientific attainments and thorough acquaintance with practice necessary for the direction of both kinds of work are rare, and are likely to be rare for many years to come. We therefore hold, that, when such a man cannot be secured and kept as director, the disadvantages of segregation will be less than the disadvantages of having either the scientific experiments, or the verification in practice of their results, undertaken by incompetent hands. The separation would be in management, not necessarily in either time or space. There appears to us to be comparatively little danger that the work of American experiment-stations will be too rigidly scientific, and too far removed from the apprehension of farmers. There is a constant pressure upon a station for immediately useful results, and any station refusing reasonable conformity to it will not enjoy a long life. On the other hand, there is danger that this pressure for immediate and striking results may lead to a neglect of the scientific functions of such an institution.

THE SECOND series of the *Johns Hopkins university studies in historical and political science*, being the twelve numbers for 1884, is just completed; and Dr. Adams, its editor, may congratulate himself on his continued success in grouping together the monographic essays of the younger school of historical writers, who are arrayed under his supervision, and bow to one of Freeman's characteristic utterances, that 'history is past politics, and politics is present history.' These papers evince a new school of historico-political students, who carry antiquarianism beyond a dry assortment of agglutinated facts, and humanize it by connection with social development. The study of institutional and economic history,

in its direct connection with social progress, brings with it an urgent plea for recognition as conveying into the study of the past a good deal of that critical spirit and close observation which have made the laboratory and the closet twin arenas. In its reaction from the broad generalization, and the rotund expression which was so easily generated out of the now antiquated method, there is some danger, it is true, of the magnifying of minuteness beyond its inherent deserts; but it seems quite clear that the hither following upon the thither swing of the pendulum will bring a rest within a happy mean. The experiment is going on successfully, and every one interested in the orderly arranging of historical results will watch its further progress with interest.

THERE ARE sceptics among scientific men as well as among other professional men; and we have no desire to plead extenuating circumstances in favor of those so-called scientific men who claimed that steam-navigation would be a failure, or that ocean-telegraphy would be impossible. The believer in the truth of alleged psychical phenomena must encounter scepticism, and the newly formed psychical society must expect to receive many suggestions of doubtful expediency from both the learned and the unlearned. What no man knows, even the uneducated and untrained can pretend to know. The time may come when it will be not unusual to study 'veridical phantasms' by polarized light, and to observe their behavior in a magnetic field. What the result will be to physical science, it is difficult at present to perceive. It is not difficult, however, to conceive of a great influence upon imaginative literature. Why should not a devotee of psychical research add another scene to Hamlet, in which is displayed a psychical laboratory, with rows of bottles labelled 'reagents for ghostly odors,' 'tests for fragments of bogies,' and 'supersensual platform scales'? In the midst is Hamlet testing the kingly ghost. A favorable analysis would go far to explain the strength of Hamlet's convictions, which

have so long been a deep study to psychologists.

Considering the renewed interest in archeological investigation, is it not surprising that there should not be an archeological psychical society,—a society, which, in place of exhuming relics of other civilizations, should endeavor to get closer to the primitive state of man by trying psychological investigations upon Eskimo, natives of central Africa, or the denizens of King Prester John's dominions? The complicated civilization of to-day is fast destroying these more or less original types. If the physicians of the time of Chedorlaomer had taken careful measures of the physical dimensions of the giants of those days, and had made experiments upon their appetites and their sense of color (which, of course, must have been enormous), we should have had accurate data in physiology and psychology, which could compare favorably with that we have in archeology.

An accurate study of a pure African's nervous organization, of his instincts, his sense of color, his hypnotic conditions, his reasoning powers in general, must be taken now, or the world will soon lose forever the opportunity. The steam-engine and the telephone will soon change the sable athletic rover of the underwoods to that higher state of civilization which, it is true, obliterates all those fine instincts we also had once in common with our animal ancestors, yet gives us in return nervous prostration, and the ability, it may be, to smell ghosts. Here is a great field of investigation, for the neglect of which our descendants will bitterly reproach us. If we are in search of a name, we might term the subject to which we desire to call the attention of the Psychical society, 'Darwinian psychology.' Is it not reasonable to suppose, that, by careful and systematic observations on young Eskimo and young Africans, we can gain a knowledge of still more primitive men, who, alas! are now only 'veridical phantasms'?

In physics, Fourier's theorem enables us, from certain measurements of temperature, to determine what will be the probable heat of the earth some time in the future. What we need in psychology is a psychical theorem, retrogressive in its character. The surroundings of man daily grow more varied; and his resemblances to his animal ancestors, it is claimed, are fast disappearing. Now is the time to sound a warning note. Our original psychical sources are disappearing. Instead of weighing a lusty African who will tip the scales at a hundred kilograms, we shall soon be reduced to weighing 'veridical phantasms' which we suppose must be below a fraction of a milligram. Back to the original sources, say we! This is the cry of all scholars, and psychists can form no exception to the general rule.

LETTERS TO THE EDITOR.

** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.

The functions of experiment-stations.

REFERRING to the editorial comments on this subject in the issue of *Science* of Dec. 5, I cannot omit to interpose a demur to what appears to me to be a somewhat narrow view of the proper functions of experiment-stations in this country, and one which, if understood to be the prevailing one, would quickly put an end to the popular demand for the establishment of such stations, especially in the newer states.

If it is not one of the essential and primary objects of agricultural experiment-stations to render to the agricultural population the scientific aid which they so sorely need when brought face to face with new and untried conditions and factors in a new country, in order to afford them relief from the slow tentative process of blind experimenting by which the solution of practical questions is commonly approached, then, indeed, the *raison d'être* of such establishments will be seriously questioned in all but the older states, where the *otium cum dignitate* of purely scientific investigations can be indulged in without leaving undone things that ought first to be done.

If the experiment-stations do not do this work for the farmer, who is to do it? It is not certainly the function of the agricultural colleges as such, although in very many cases their greatest present usefulness assuredly lies in that direction; since their direct influence through the few students who hasten through a superficial course in their halls will long remain insensible, unless supplemented by such practical demonstration of the usefulness of agricultural science as the experiment-station work can afford. From both the practical and the educational point of view, then, those functions to which the article in question allots a second place, should, in my view, be placed first.

Again: it is said that to unite the two functions of an experiment-station — the scientific and the practical — in one institution and under one management is of doubtful propriety. So far from admitting this, I hold that nowhere can scientific investigation be more fruitful than where, in this direct connection with practice, it is brought face to face with new conditions, and therefore with new phases and aspects of old problems. I think it would be a grave mistake to segregate the two branches of the work, whether in space or time, and most especially to intrust the solution of practical problems to persons of inferior qualifications, as is too commonly done, to the detriment of the cause of science, and to the disgust of those engaged in pushing it in the face of the difficulties it naturally encounters in a new country. There is a limit to the usefulness of differentiation, when each of the segregated branches is thereby trimmed down to narrowness, and want of proper co-ordination with the other. In our widely varied domain, each location affords peculiar advantages for the prosecution of some branch of both pure and applied agricultural science; and those in charge of the several stations should know, or carefully consider, in which direction their greatest usefulness (in the widest sense of the word) lies.

No one narrow definition of the proper duties and functions of agricultural experiment-stations can apply to all cases alike. Each station will have to adapt its mode and scope of operations to the surrounding circumstances; and the good judgment exercised in determining these points will in a great measure determine also the scientific as well as the practical usefulness of such an establishment. With any thing like an adequate endowment, the two branches are not only compatible, but will fertilize each other, as does the combination of investigation and instruction in the case of teachers. The abstract investigator will rarely shape and express his ideas as clearly as the one who is habitually compelled to put them into the proper form for the understanding of others; and the same is measurably true of the experiment-stations, in which scientific work, and that intended for the direct instruction of the contemporary population, should go hand in hand. It does so even in Europe, where the practical questions needing determination are much fewer and less intricate; and, if it be contended that a different policy should be adopted in this country, the *onus* of showing the reasons therefor certainly devolves upon the advocates of the new doctrine.

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The most economical size of electric-lighting conductors.

In *Science*, No. 97, p. 524, Professor Carhart points out an oversight of mine (No. 94, p. 477) in leaving out the cost of waste heat in the conductors as a part of the economy in the Edison three-wire system, and also a mistake in estimating its amount; in both of which I am glad to be corrected. But Professor Carhart has not, I think, quite reached the most economical result, for the reason that we have the interest on n conductors, but heat developed in *only two* of them; and, as it seems worth while to develop the complete solution for this interesting system, I further submit the following:—

Suppose the size of conductors in the two-wire system to be such that the interest on their cost equals that of the heat-energy developed in them (C^2R , using Professor Carhart's nomenclature), which, for simplicity, we will take equal to unity. The general